XVI. Contributions to the Life History of Polyommatus eros. By T. A. CHAPMAN, M.D., F.Z.S.

[Read October 7th, 1914.]

PLATES LXIX-LXXXIV.

I HAD long had a wish to know something of the lifehistory of *Polyommatus eros* and to see its, so far, unknown larva. The first practical step was, of course, to determine its food-plant (or food-plants). No satisfactory opportunity to do this occurred to me until in July 1912, at Val d'Isere, I found the species not uncommonly. It occurred most freely where *Oxytropis campestris* grew, and I succeeded in observing a butterfly laying its eggs on this plant.

As I note later, I secured some eggs and got the larvae into hibernation, but got none past the hibernating (third) instar.

At Le Lautaret, from the 21st July to the 5th August 1913, P. eros occurred practically everywhere. It was certainly most abundant at two or three places where Oxytropis campestris grew in quantity, and less so when the Oxytropis was more scattered in growth. It was also fairly common in places where Astragalus aristatus flourished. Its more general distribution in smaller numbers probably depended on Phaca astragalina, which was not often abundant but grew almost everywhere. The butterfly was seen to lay eggs on these plants, and the larvae ate them readily. There was also a plant, Astragalus onobrychis, which grew freely in one or two spots at Bourg d'Oisans, much below the limits of P. eros, but the leaves and seed pods of which seemed so very much like those of O. campestris, that I offered it to the larvae of P. eros and they ate it as readily as the Oxytropis. With these four plants nearly equally acceptable to the larvae, it is very unlikely that there are not other allied plants that they would also readily eat. The butterflies were seen at various elevations. Nearly as low as 5000 feet towards Monetier where the food-plant was probably the Astragalus aristatus, and up to 7500 feet where Oxytropis campestris was abundant. They probably occurred TRANS. ENT. SOC. LOND. 1914.—PARTS III, IV. (FEB.)

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much higher, but suitable localities, *i.e.* areas of food-plants, did not happen to be met with. The $\mathcal{J}\mathcal{J}$ were seen abundantly during the whole period noted, July 21 to August 5, but it was only towards the end of the period that the QQ were seen in any numbers.

Though the larva of P. eros is quite properly described as hitherto unknown, it is the case, as I learned from M. Rondou when I saw him this summer (1914), that he had bred P. eros from larvae found on Oxytropis pyrenaica, a plant closely resembling Phaca astragalina (or a plant very close thereto, on which eros feeds at Le Lautaret), one of the alternative foods on which P. eros larva feeds. In admitting some haziness as to this plant, I must plead that there are a good many species, or at least several, that are so much alike, that I at least cannot distinguish them when only the leaves are available.

In both 1912 and 1913 I succeeded in getting a fair number of larvae to go into hibernation, but failed to bring any through the winter of 1912–1913. The following winter I was more successful, by means of keeping the larvae iced during the winter, and bringing them up early and forcing them, as I found they were beginning to die off. Of these I succeeded in getting only one into its last instar, when it also finally died. The unsuccess was probably facilitated by the food-plant having to be forced as well as the larvae and was rather drawn up and succulent.

Eggs were laid at the end of July by females taken on the Route de la Thouviere, Val d'Isere; the males were common in many places near Val d'Isere, the females were however rather scarce. The young larvae hatched during the first week in August, they were placed on Oxytropis campestris and eat it readily; the eggs also were laid on this plant, but not on any other offered them, this was suspected to be the (or a) food-plant from being present wherever the butterflies were at all common. They afterwards eat also a plant that was brought home last year as Phaca astragalina as food for L. pheretes, but was seen this spring to be different from other specimens brought as that plant. It was supposed to be possibly *Hippocrepis*, which it very closely resembles, but is seen to possess a more hairy leaf with a raised midrib below (flowers not seen). At any rate eros eats it readily, but will not look at *Phaca* or *Hippocrepis*.

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At Le Lautaret in 1913 the butterflies in captivity laid freely on Oxytropis campestris and Astragalus aristatus, and the larvae eat both these plants with equal readiness. *Phaca astragalina* (?) was less welcome to butterflies for laying, and to larvae for eating, but was obviously quite a practicable food-plant.

The egg is almost exactly 0.5 mm. in diameter and about 0.26 mm. high. The top can hardly be called flat, certainly not as it is in *coridon*, etc., *i. e.* there is not a definite line at which the flat top ends and the rounded side begins; the curve of the side seems to be continuous right on to the top, and falls a little into the micropylar hollow. The micropylar area is about 0.075 mm. in diameter. Its structure and the sculpture of the egg may be gathered better from figures 14 to 17 than by long description. The cells of the egg sculpture maintain their full size close up to the micropyle, where there is a slight tendency for them to have their dividing walls arranged radially. The cells are about 0.025 mm. in diameter, there are distinct but very small knobs at the junctions of the walls of the cells.

The eggs are laid on the undersides of the leaflets of the food-plant.

When it leaves the egg, the larva eats approximately the upper half of the shell, the instances are comparatively rare in which it does not eat the whole of the top and more or less of the sides, with some regularity all round.

The newly hatched larva is less than 1 mm. in length, nearly colourless, faint ochreous, hair bases dark, head black, legs dark. In the 2nd instar it is rather larger, much the same in colour, but the black hair bases are very pronounced though less conspicuous after the larva has grown a little, when it exhibits (differing a little in individuals) some traces of darker oblique markings. The 3rd instar was assumed about 3rd September (some earlier, some later).

The larva in this instar is at first somewhat featureless. When somewhat grown it may be noted as on Sept. 10, length 3.5 mm., colour pale ochreous, with sufficient green to give an olive tone especially to the front segments. Head black, legs ochreous like body; outline (anterior or posterior view) angular, with the Lycaenid dorsal and lateral flanges, the former rather rounded, but both accentuated by the more abundant and longer hairs, which

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are pale rufous. The markings which are not very strong are a pale line down each side of dorsum and along each lateral flange and a rather darker line down mid-dorsum and one half-way down "slope" outlined paler below. There are paler markings at anterior extremity.

The clothing of hairs, lenticles, etc., in the 1st instar conforms closely to the ordinary arrangement of these structures in the Plebeiids; comparing Figs. 18 and 19 with those of *P. icarus* and *A. thersites*, for example, in Plates XXXVII and XXXVIII, Trans. Ent. Soc. 1914, a little difference in the outline of the prothoracic plate appears, but the only marked difference is in the two hairs above the spiracles (III?). In *icarus* and *thersites* the hair points or bases are present, but any hairs are very minute or evanescent, in *eros* the anterior of these has a hair about 0.075 mm. long, longer on 6th abdominal segment and on 7th 0.15 mm. long, quite comparable with the hairs of tubercle I which are 0.2 to 0.225 mm. long. The posterior of these two tubercles (III?) has a minute hair about 0.02 to 0.025 mm. long.

In the 2nd instar the disposition of hairs and lenticles is very similar, though there is some little difference in the boldness of the hairs.

The larvae hibernate in the 3rd instar; no exception to this was observed, their appearance at this stage is well shown in Figs. 1 to 4. At this stage they contrast with the larvae of P. *icarus* and A. *thersites* in being much browner, hardly to be called green at all, the tone of the majority being that shown in Fig. 4.

The armament in this stage is apparently of much the same character as in *icarus*, *thersites*, etc., though the strength of tubercle III is still shown by there being two moderately long hairs at this position, the other species having only one.

My 1913 notes say—

February 8.—Brought a larva from refrigerator into warm room.

February 11.—Larva began to move, and being put on leaf of *Oxytropis campestris* began to eat.

February 12.—Has mined out a portion of leaflet and made some half-dozen small pellets of frass.

February 14.—Continues eating; has attacked 5 or 6 leaflets (still small), hardly looks any larger.

February 16.—Still eating, looks decidedly larger.

February 19.—Gave a fresh bit of leaf yesterday; has attacked two leaflets. Brought rest of larvae to warm room.

None of these larvae reached the 4th instar.

In 1914 it appears that about January 22nd I brought up some larvae and put them on a growing plant of *Oxytropis campestris*, they disappeared, but on February 1st one shows itself.

February 3.—Two larvae are obviously feeding, 3 are altogether in evidence.

February 9.—There are now five larvae in evidence, three of those noted above and 2 on a plant that was left out of doors all winter till 5 days ago. There are still a few larvae apparently alive in "cold storage."

February 19.—Larvae have been brought up and put on growing plants of O. *campestris* at various times in the last fortnight or so. Only a few survive.

One in the 4th instar (moulted since brought up), is when contracted 3.5 mm., probably 4.0 or over if moving. It is dull green, which has a rather dirty tint owing to the numerous black hair bases. There is a yellow tint down each side of the dorsum. The whole larva has a rough look owing to the comparatively long hairs, especially those on the dorsal and lateral ridges, which are of somewhat smoky tint. They are 0.4 or even 0.5 mm. long.

March 8.—A larva (No. 1 in 4th instar) 5.5 mm. long, very difficult to detect as it rests beneath a leaflet of O. *campestris*, its green being of much the same shade as that of the plant, and though it is covered with the minute black dots of the hair bases these merely help to give an effect of shadow, not otherwise very strong as both the leaflets and the larva are quite translucent, even in a moderate light. The hairs, which are longer and more abundant than in other Lycaenid larvae I know, merge very well with those of the plant, though the latter are colourless and those of the larva have a distinct brownish shade.

This larva is now quite green, with a brownish tinge on the prothoracic plate. Looked at in front the dorsal and lateral hairs make a very strong appearance, the hairs are quite 0.4 mm. long, there is a series of hairs of about half the length and fewer in numbers half-way up the slope. The larva is by no means fully grown in its present

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instar. judging from the density of the hairs and the hollowness of the slope, though no doubt the abundant dorsal and lateral hairs make the flanges seem higher and consequently the hollow of the slope greater than they are in reality. There is a faint indication of a possible pale lateral line, and less so of a dorsal one.

It still feeds by mining, by means of its long neck, between the two cuticles of the leaves.

A larva (No. 2) 4.5 mm. long, possibly in same instar as No. 1, is much the same, except that it is of a yellowish or brownish tint overlying the green, as though the skin colour was dominant over the green colour of tissue or fluid beneath; it has no indication of dorsal or lateral line, the hairs seem rather darker and are certainly not quite so long, suggesting it is really in an earlier instar.

Larva No. 3 is still smaller and apparently laid up for moult; these are all the larvae of *eros* that now remain; they are remarkable as compared with *A. thersites*, being at the stages above indicated, whilst *thersites* brought out of cold at same date are now emerging as imagines.

Their small numbers prevents one treating them with any disrespect for examination, etc.

March 17.—A larva of P. eros apparently full-grown in 4th instar eats half thickness of leaf or even sometimes whole thickness, but these leaves are small, thin and succulent (forced).

When walking it is just over 5 mm. long, 2 mm. broad, 1.6 mm. high, of a dull green colour (decidedly a clearer brighter green than thersitis or icarus at this stage), hair bases of long hairs in flanges and some at middle of slope black, faint yellow lateral line indicated, dark dorsal line (vessel), paler along dorsal flanges and of oblique lines along slope rather imagined than seen. The smaller hairs have also dark bases, but less dark than those of the larger basis, or being so much smaller seem to be so. The honey-gland is surrounded by comparatively few lenticles, etc. The long hairs are quite 0.5 mm. long, of a faint brown tinge, quite conspicuously brownish taken together.

March 20.—The yellow lateral line is now quite distinct, almost bright, it is wanting in the other specimen.

March 26.—The larvae have been eating up to date, but seem to-day to be settling down for moult.

March 31.—One larva has moulted this morning.

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April 1.—Has commenced to eat after some 6 days' fast. April 2.—No. 2 has not yet changed. No. 1 is eating very deliberately, he eats the whole thickness of the leaflet (which is however much slighter than the strong leaves found on the plant in summer).

At rest it is about 5.5 mm. long, 2.3 mm. broad at 1st abdominal, narrowing just appreciably to 7th abdominal and then rapidly to the rounded posterior extremity. The colour is a rather dark apple green, faintly paler, but not approaching yellow along the dorsal ridges. The hair bases are numerous and rather dark, but too small to produce much colour effect except along the dorsal and lateral ridges. The spiracles are conspicuous, brown, the prothoracic plate is dark and so very visible. The lateral flanges stand out as very definite "flanges," as they probably do not do when the larva is full fed.

The dorsal and lateral hairs look strong and stiff, dark, brown rather than black, 6 or 8 on each eminence, longest about 0.5 mm. long. The honey-gland is obvious but not conspicuous. The fans are rather conspicuous white spots, they have been seen partially everted and then are very conspicuous.

No. 1.—Died April 3rd.

No. 2.—On April 9th had not changed, remained lethargic till yesterday it eat a little; it has one or two ominous black spots.

It was dead a day or two later.

My efforts to rear the larva from the egg having thus failed, the only available resource was to find the larvae at home in the spring, and so, finding I could manage to do so, on the 23rd May 1914, I went to Le Lautaret. The 21st and 22nd had been very fine, warm days, the 23rd looked doubtful, but for three hours in the afternoon I found it warm in the sun, although there was a strong wind, at the locality (7000 odd ft.) where Oxytropis campestris was most abundant. The first plant I looked at was one of sainfoin, and on this I found a larva of A. thersites conspicuous about the centre of the plant, leaves $2\frac{1}{2}$ to 3 inches long. The few further plants of Onobrychis I looked at did not afford another. On Oxytropis I found four larvae all rather small, so small that one could not be sure what they were. The 24th it rained all day. On the morning of the 25th, in a rather cold wind, I again looked for larvae in the same locality, and found 8 or 10, again rather small, on Oxytropis.

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None of the larvae taken on *Oxytropis* seemed to be thersites, but whether they were *icarus* or eros or both was quite impossible to say. They were found generally beneath the leaf petioles, usually, however, after having dropped from these amongst rubbish below. One was found by searching, after first detecting its cast skin. Two other cast skins were found, but the corresponding larvae could not be found; the larvae when so small no doubt were easily lost by falling amongst the rubbish below the plants, one was found on a stone beneath a plant. The larvae were nearly all very small, apparently recently moulted into the 4th instar.

They eat the interior of the folioles through a small aperture, like the work of a *Coleophora*, of which also a pistol-shaped case was noticed. Small larvae of *Hetero*gynis to the number of a dozen or two were seen on the *Oxytropis*, generally very obvious and exposed towards the ends and uppersides of the leaves.

As they grew these larvae in the 4th instar varied but little from each other, but were so like *icarus* at this stage (I had no living larvae of *icarus* by me for comparison, and had to trust to memory) that I felt quite uncertain whether all were *icarus*, all *eros*, or a mixture of both, they were certainly not *thersites*. These three species all flew at the locality where I found the larvae in fairly equal numbers. Their general appearance is well shown in Figs. 5, 6 and 7.

The same doubt continued when the larvae reached the last (5th) instar, indeed it became intensified by certain peculiarities.

A note made on June 7th shows that one larva out of 6 that were doing well seemed larger and of much brighter colour than the others. Had I one larva of one species and five of another?

Of the supposed (or hoped-for) *eros* 5 seem nearly full grown, one of them looks younger than the others but is larger, i. e. it is flatter and wider and more active, eating freely, the others are perhaps only sulky but are short, round and bunched.

No. 1 is 12 mm. long, has a bright yellow dorsal and lateral line, the latter very narrow and defined, but bright enough to make the lateral hairs look yellow, when seen through them. The dorsal line seems to diverge a little on each segment, *i. e.* the distance is greater between them at the posterior than at the anterior border of the segments, they cease abruptly with the 6th abdominal segment. There are two faint oblique yellow lines on each slope, and a third less plain at the spiracle, equidistant from each other. The lateral flange hairs are faintly brown, most of the dorsal blackish. The hair bases are dark but not black and rather inconspicuous. The ground-colour is a pale almost yellowish grass-green. (Figs. 8 and 9.)

June 7, 1914.—The other 4, or 3 at least, are smaller, 10–11 mm., much darker green, the yellow lines much the same in position, etc., but dim and obscure, instead of bright and prominent. The yellow lines on slopes just visible and only in some lights. All hairs darker than in the first larva; supra spiracular row of hairs similar to those of the other except that they are more conspicuous in last segments. (Figs. 10, 11, 12.)

June 25th.—Of the above 5 larvae all duly pupated, together with one other (the sixth), between the 15th and 20th inst.

A special note of the variation in the larvae was taken when the question as to whether they were all of one species was in doubt.

June 11, 1914.—(1) A larva about full grown with very brilliant narrow yellow lateral line, dorsal line, only a rather yellower green than grass-green ground-colour, oblique lines even less clear, long hairs all rather dark, one or two nearly black on middle of slope, each segment.

(2) A similar larva, but hairs nearly colourless and dorsal yellow lines rather more distinct.

(3) Three smaller larvae with lines more distinct, one with ground-colour almost a yellowish green.

(4) A smaller larva (in 4th instar) has rather darker ground-colour and proportionally rather darker and longer hairs. ? is this the only *eros*?

(5) A larva like 1st, but dorsal line on 1, 2, 3 and 4 abdominal is wanting on right side.

The remainder were decidedly smaller and rather more uniform in tint, and fed very slowly. Were these smaller larvae *eros* and the first six something else, *icarus* probably? These smaller larvae are represented by Fig. 13.

In the event, there could be no doubt that all my larvae were eros, and that I had found no larvae but eros on the

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Oxytropis campestris, the differences in the first six were mere variations in the larva, and the remainder differed owing to their being parasitised.

It follows, by the way, that *P. icarus* in the locality at Le Lautaret where I got these larvae does not affect *Oxytropis campestris*, there are there plenty of other *Papilionaceae* for it, including its favourite *Lotus corniculatus*. The six or eight larvae that proved to be parasitised "never grew larger, and at about half the size (bulk, not length) of the others retreated downwards into any available narrow space and then took a cylindrical form, became fastened by a little effusion from the mouth and dried up into a brown cyclinder, in which state they remain, and are almost certainly the hosts of some ichneumon, size 7.5 to 9.0 mm. long, 2.5 to 2.8 mm. wide in different specimens. The fastening by the head makes one suppose it is the tail end till specimens are more closely inspected."

The following notes made on the pupae of *eros* when it was supposed more than one species might be represented in my material, with a view to finding some distinctions between the (supposed) species, will serve to show the extent of variation in the pupae of P. *eros*.

June 20.—No. 1, the largest and most striped (oblique) larva, has a very transparent pupa, faintly greenish, 11 mm. long, wings very glassy, showing tracheae; there are a good many *very* short hairs over head and prothorax. There is a waist (seen laterally) about 3.5 mm. high, prothorax and 3rd abdominal about 3.8.

June 26.—Wings are now satiny white, eyes brownish and whole pupa more solid looking.

June 20.—Pupa of larvae 2 and 3, extremely like No. 1 as to colour, transparency, etc., hairs rather more obvious especially along abdomen, where they can hardly be seen in No. 1. They are also a little smaller, 10.5 mm. long, but about same height. Larval skin covers last segments in both. No. 1 is nearly free, this one has a "girth" consisting of several threads on each side arising from position of lateral pad, but taking separate directions one over prothorax, one over 1st abdominal and one going right back to 6th abdominal segment; there are also a few oblique and one or two longitudinal threads, uniting these several strands, so that though the structure hardly exists still it seems as much entitled to be called a cocoon as a girth. The larval skin is quite free from any pad or other spinning. Another specimen is quite free like No. 1, and seems also less hairy.

No. 4 is also free, No. 5 has some spinning and has abdominal hairs, No. 6 is free.

June 26.—Nos. 2-5 are showing thickening of wings and darkening of eyes, No. 6 less so.

June 27.—A parasite emerged from a brown (dead?) larva.

June 28.—Another parasite emerged.

It is to be noted that the pupae (healthy) were formed some days before the stung larvae dried up, but the parasites are emerging whilst the pupae have still some days to go. (They have now brown eyes and opaque wings.)

June 28.—These pupae show the fore-wings, with a wide vacant margin behind them (occupied by hind-wings??), and the wings have a broad margin beyond where the nervures reach to.

June 30.—1st specimen (No. 3) emerged, eros 3.

Five of the parasites have emerged, 2 remain unemerged. July 1.—2 \mathcal{J} and 2 \mathcal{Q} emerged. No. 1 \mathcal{J} , 2 \mathcal{Q} , 4 \mathcal{Q} , 5 \mathcal{Q} . They emerge between half-past 7 and 8. They leave no meconium in the pupa case.

It thus appears that all my larvae were *eros*, and that there were amongst them no *icarus*.

July 3.—The last imago (No. 6) emerged—a \mathfrak{Q} . Another parasite.

The latter (in pupa) was isolated, and the observation was thereby verified that though the hole of emergence, on the back of the last segments of the dry and hard larva skin, has the appearance of a lid having been cut out leaving a round hole, there is in fact no such lid and the hole is made by gnawing away the material. There is no lid discoverable, but a fair amount of frass-like material lying about the hole, the chips or sawdust resulting from the gnawing up of the stuff removed to make the opening. July 4.—7th and last *Rhogas bicolor* emerged.

I sent some of the parasites reared from *P. eros* to Mr. C. Morley, who writes me that I send him "*Rhogas bicolor*, Spin. It is a common Braconid (not Ichneumonid) from Italy to England and Scotland, also taken by me in Mayo. It is said to have been bred from *Zygaena filipendulae* and *Leioptilus tephradactylus*, Hubn., only."

EXPLANATION OF PLATES.

Plate LXIX, fig. 1, *P. eros*, larva in third (hibernating) stage natural size.

Figs. 2, 3, 4. Three figures of third stage larvae enlarged, the brownish coloration of figs. 3 and 4 is especially characteristic of P. eros in this stage, in comparison with the same stage larvae of P. icarus and A. thersites, which I was rearing at same time and so could compare them.

Figs. 5, 6, 7. Fourth stage larvae (after 1st spring moult) much enlarged.

Plate LXX, figs. 8–13, last stage (5th instar) larvae, much enlarged (about \times 5).

Figs. 8 and 9 from the large well-coloured and well-marked larva. Figs. 10, 11, 12. From duller and more uniformly coloured larvae.

Fig. 13, one of the larvae that ceased growing early and appeared to be full-grown whilst still much smaller than those figured 8–12. These larvae being all collected, there was some doubt whether some of these might be *icarus* or some other species, however 8–12 all proved to be *eros*, those represented by fig.13 were all ichneumoned and were also doubtless *eros*, so that all the larvae found on Oxytropis campestris were *eros*.

These figures, as reproduced, do not do full justice to Mr. Knight's drawings. They fail especially in making the eminences of the dorsal flange on each segment smoothly rounded instead of somewhat angular, in making the eminences of the lateral flanges similarly rounded instead of flattened except just at the incisions, and in giving in some cases an appearance of smoothness contrary to the rough surface due to the hairs and hair-bases. They do nevertheless give a very good idea of the colour and general aspect of the larvae.

Plate LXXI, fig. 14. Eggshells of P. eros $* \times 40$.

Plate LXXII, figs. 15, 16, 17. Three examples of the micropyle of the egg of *P. eros* \times 350.

Plate LXXIII, fig. 18. Skin of first stage larva \times 80.

* Selected as least injured by larvae in hatching.

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LARVAE OF P. EROS.